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AUTOADJ: A Computer Program for Entering Constraints for Polygons in IRAS and IRPM

J. Greg Jones
Mary L. Meacham[1]

ABSTRACT

AUTOADJ is a computer program for creating adjacency and mutually exclusive constraints for polygons in the Integrated Resource Analysis System (IRAS) and the Integrated Resource Planning Model (IRPM). It is interactive and operates on the Forest Service's Data General system.

KEYWORDS: adjacency constraints, adjacent polygons, Data General software

Adjacency constraints prevent undesirable combinations of management projects from being scheduled on adjacent polygons in Integrated Resource Analysis System (IRAS) models (Jones and others 1989) and in Integrated Resource Planning Models (IRPM) (Kirby and others 1980). A common application of adjacency constraints is to prevent selecting adjacent polygons for harvest within the same time period or within two or more consecutive time periods.

Preparing the data for these constraints manually is **very** time consuming and tedious. Moreover, it is easy to inadvertently omit one or more common boundaries. The result is an invalid model that can be corrected only by adding the missing boundary specifications to the data and regenerating the model.

AUTOADJ is a computer program automating data entry for adjacency constraints in IRAS and IRPM models. In addition, AUTOADJ creates another type of constraint commonly used in these models—a mutually exclusive constraint for each polygon. These constraints allow the selection of only one management option per polygon.

AUTOADJ operates on the Forest Service Data General (DG) system. It is interactive, but relies on two files for input. One is an input file for the IRPM matrix generator (also used in IRAS). The second is a file listing neighboring polygons. This note describes the operation of AUTOADJ.

[1]J. Greg Jones is a Research Forester and Mary L. Meacham is a Statistician. Both are located at the Intermountain Station's Forestry Sciences Laboratory, Missoula, MT.

OVERVIEW

The information for building adjacency constraints with AUTOADJ is entered interactively. But data for the adjacency constraints and the mutually exclusive constraints for polygons come from two previously built files. Both must be located on your DG system. One is the input file for the IRPM matrix generator called DATA.PRELIM. This file contains data for the resource projects, which are the land management options for the polygons. AUTOADJ uses this file to develop a comprehensive list of resource projects. Readers are referred to the IRPM manual (Kirby and others 1980) for the format of DATA.PRELIM.

The other file, called the polygon neighbor file, contains a list of adjacent polygons. This information is entered in file form to provide flexibility. It may, for example, be built electronically using digital map data, or built manually using a text editor. (The format for this file is presented later.)

AUTOADJ requires that the resource projects in DATA.PRELIM be coded with the convention adopted for IRAS:

Resource Project Coding = XXXXIT

where:

XXXX	=	A numerical code representing the polygon to which the resource project applies. All four digits must be used. (For example polygon 1 would be coded 0001.)
I	=	An increment code (number 0-9 or a letter A-Z) used to differentiate among resource projects implementable in a common time period on the same polygon.
T	=	The time period (number 1-5) associated with a resource project. This period is used by AUTOADJ in formulating the adjacency constraints. For example, resource projects having a value of 2 for T would be included in the period 2 adjacency constraints.

AUTOADJ provides the option of excluding resource projects having specified increment codes (I) from the adjacent constraints. This might apply, for example, to

resource projects representing selective harvesting, which is permitted on adjacent polygons. To accomplish this, all selective harvesting projects in DATA.PRELIM would be assigned the same increment code, say the number 9. Then, specify in AUTOADJ that resource projects having this increment code are to be excluded from the adjacency constraints.

AUTOADJ uses the approach described in Meneghin and others (1988) to build what are called "type 1" adjacency constraints. In these constraints the sum of a group adjacent resource projects is constrained to be less than or equal to one. For example, a "type 1" adjacency constraint including projects X_1 through X_4 would be formulated as:

$$X_1 + X_2 + X_3 + X_4 \leq 1.$$

Because the value of 1 for a resource project means that the resource project should be implemented in its entirety, the solution process may select at most the equivalent of one whole project from this group of adjacent projects.

The mutually exclusive constraints, which allow the selection of only one resource project per polygon, are formulated in the same manner. The sum of all resource projects applying to a specific polygon is constrained to be less than or equal to 1.

The output from AUTOADJ is written to a user-specified file, and is in the format required by the IRPM matrix generation process. This file should be placed in the NCC-FC file called DATA.USER-MCARDS along with the specifications for other types of constraints to be included in the IRAS or IRPM model.

ACQUIRING AND RUNNING AUTOADJ

Two files are needed to run AUTOADJ, the executable FORTRAN program (AUTOADJ.PR) and a sort procedure (AUTOADJ_SORT). Copies of these files can be obtained from the Intermountain Research Station using the DG file retrieval procedure. The information for retrieving these files is as follows:

Host Name: S22L01A
Level: 2 (staff)
Staff Name: ECON
Drawer Name: PROGRAMS
Folder Name: PROGRAMS
File Name: AUTOADJ.PR
AUTOADJ_SORT

The retrieved files should be stored in IS/CLI and given the same names.

To execute AUTOADJ, type 'X AUTOADJ' on the IS/CLI command line. First the banner page appears on the screen. It is important to note: (1) the functions available (INDEX = Shift-F2, and BACKFIELD = Shift-F11) and (2) this program can be terminated at most locations by typing 'stop'. Press <NEWLINE> to continue.

Next, the two main program options are listed. Select '1' if AUTOADJ is to build ONLY the mutually exclusive constraints for the polygons in a model. Select '2' if AUTOADJ is to build BOTH the mutually exclusive constraints for the polygons and the adjacency constraints.

After the option is selected, the user is asked for the names of the two input files and the output file. If program option '2' is selected, the name of the polygon neighbor file is requested first. (See "Polygon Neighbor File" for the format requirements.) AUTOADJ checks the first line of the file specified to ensure that it contains the letters 'ADJ' in columns 1-3. If not, the file name provided is rejected and the user is asked to supply the name of a valid polygon neighbor file. (Note: the program can be terminated at this point by typing 'stop'.)

The next file name is requested for both options. This file contains the input data for the IRPM data file called DATA.PRELIM. AUTOADJ checks this file for format. If the format is inconsistent with DATA.PRELIM, the user is asked to enter another file name. (Readers are referred to the IRPM manual (Kirby and others 1980) for the format of DATA.PRELIM.)

The final name requested is for the output file. AUTOADJ writes the data for both the mutually exclusive constraints for the polygons and the adjacency constraints to the file specified. If data errors are found, however, error statements are written to this file instead.

If program option 1 was selected (create only mutually exclusive constraints for the polygons), AUTOADJ begins processing data upon entry of the file names. If option 2 was selected, AUTOADJ asks if any increment codes should be omitted from adjacency constraints. If answered 'Y' the user is asked to supply the increment codes for resource projects to be omitted. Up to 36 increment codes can be entered. (See coding for resource projects under Overview for a description of increment code.) All resource projects having the specified increment code(s) will be omitted from the adjacency constraints.

Next, AUTOADJ requests the periods over which the adjacency restrictions apply. A separate "set" of adjacency constraints should be created for each period or sequence of periods, within which adjacent units are not to be harvested. Press <NEWLINE> on an empty field to continue the program after all adjacency sets have been specified. Specifying adjacency sets is illustrated below with two examples, each containing three time periods.

Example 1: Adjacent polygons are not to be harvested within two consecutive periods. (Two adjacency sets are required: one to specify that adjacent polygons cannot be harvested in periods 1 and 2, the other to specify that adjacent polygons cannot be harvested in periods 2 and 3.)

Adj. constr. set	Period(s)
A	1,2
B	2,3
C	<NEWLINE>

Example 2: Adjacent polygons are not to be harvested within periods 1 or 2, or within period three. Adjacent polygons may be harvested in periods 1 and 3, or 2 and 3. (Two adjacency sets are required: one to specify that adjacent polygons cannot be harvested in periods 1 and 2, the other to specify that adjacent polygons cannot be harvested in period 3.)

Adj. constr. set	Period(s)
A	1,2
B	3
C	<NEWLINE>

After <NEWLINE> is pressed without entering another time period, AUTOADJ computes the data for the mutually exclusive constraints and the adjacency constraints and writes it to the specified output file. If, however, inconsistencies or errors are found, error statements are written to the output file instead.

The constraint data created by AUTOADJ must be placed in the NCC-FC file DATA.USER-MCARDS prior to running the matrix generation procedures. The final question asked is whether the user would like AUTOADJ to append the output file just created to the DG file containing records for DATA.USER-MCARDS. If answered 'Y' the user is asked for the name of the file to be appended. AUTOADJ stops upon completion of this step.

POLYGON NEIGHBOR FILE

The polygon neighbor file is needed only when adjacency constraints are to be created. It contains a list of all adjacent polygons. Polygon ID's must be four numeric characters (for example polygon 1 must be entered as 0001) and must be the same polygon ID's used for the resource projects (NCC-FC file DATA.PRELIM). Up to 900 polygons can be accommodated. The format for this file follows:

Line(s)	Column	Entry
1	1-3	ADJ (used an identifier)
2+	2-5	The pointer polygon ID. Each polygon having neighbors must appear in this location once (one record for each polygon).
2+	10-78	The polygons that are adjacent to the pointer polygon are listed, beginning in column 10. The four-character polygon ID's should be separated by either a blank or a comma. Include all adjacent polygons even though they may have already been listed on other records. Up to 14 adjacent polygons may be listed for each pointer polygon.

ERROR STATEMENTS

AUTOADJ checks for the presence of specified input files. If a specified file is not found, the user is notified and asked to provide another file name. AUTOADJ also checks the input files for key identifying features. If a specified file does not contain these key features, the user is notified and asked to provide the name of another file.

AUTOADJ also checks for two types of data inconsistencies. First, it checks the periods specified for the adjacency constraint sets against the periods associated with the resource projects (found in the data for the NCC-FC file DATA.PRELIM). There must be at least some resource projects associated with the periods specified for the adjacency constraint sets. If not, the user is notified that a particular period was not found in the land management project data, and is asked to revise the periods specified for the adjacency constraint sets.

The second data check performed by AUTOADJ compares the polygons in the polygon neighbor file with the data for file DATA.PRELIM. If no resource projects are found for a polygon listed in the polygon neighbor file the following error is written both to the screen and to the output file:

***** No Resource Projects were found in _____ for polygon ____ listed in the polygon neighbor file.**

Likely causes are (a) a polygon was mistakenly included in the polygon neighbor file and should be removed from that file; or (b) data were omitted for the specified polygon in DATA.PRELIM. Whatever the cause, this data inconsistency must be eliminated before AUTOADJ will write the mutually exclusive and adjacency constraints in the output file.

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Intermountain Research Station
324 25th Street
Ogden, UT 84401